I claim:

1. A method for compressing an animation model, the model comprising an offset model including a plurality of surfaces, each surface including a plurality of vertices, the method comprising:

predicting offset vertices of the offset model for corresponding reference vertices of a reference model associated with the offset model, using basis coordinate systems respectively associated with the reference vertices;

determining differences between the predicted offset vertices and actual offset vertices of the offset model; and

storing the differences between the predicted offset vertices and actual offset vertices to allow reconstruction of the actual offset vertices using the reference vertices and the differences.

2. The method of claim 1, wherein at least one basis coordinate system comprises a set of vertices that are either seed vertices or vertices previously traversed.

3. The method of claim 1, wherein at least one basis coordinate system is a triangle defined by three vertices nearby the reference vertex.

4. The method of claim 1, wherein at least one basis coordinate system comprises a preconfigured triangle based on a location of the reference vertex.

5. The method of claim 1, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i,k-1}$, $P_{i+1,k-1}$, $P_{i+1,k-2}$ where the reference vertex is $P_{i,k}$, and is in an odd row of the surface.

6. The method of claim 1, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k-1}$, $P_{i,k-1}$, $P_{i,k-2}$, where the reference vertex is $P_{i,k}$, and is in an even row of the surface.

7. The method of claim 1, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k-1}$, $P_{i-1,k}$, $P_{i-2,k}$, where the reference vertex is $P_{i,k}$, and is in a last row of the surface.

8. The method of claim 1, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k}$, $P_{i,k+1}$, $P_{i-2,k+1}$,where the reference vertex is $P_{i,k}$, and is the leftmost vertex in a last and odd row of the surface.

9. The method of claim 1, wherein predicting offset vertices comprises for each offset vertex:

selecting a reference vertex on the reference model and a corresponding offset vertex;

selecting a basis coordinate system on the reference model with respect to the reference vertex, the basis coordinate system defined by vertices nearby the reference vertex, the basis coordinate system providing the basis coordinates for the reference vertex;

selecting a basis coordinate system on the offset model;

determining a position of the reference vertex in the basis coordinate system; and

predicting the offset vertex by applying the position of the reference vertex in the basis coordinate system on the reference model to the basis coordinate system on the offset model.

10. The method of claim 9, wherein selecting a reference vertex on the reference model comprises traversing the surface of the reference model in a zig-zag pattern.

11. The method of claim 9, wherein predicting the offset vertex comprises:

determining a reference vector for the position of the reference vertex in the basis coordinate system on the reference model; and

determining a corresponding offset vector for the reference vertex in the basis coordinate system of the offset model.

12. The method of claim 9, wherein predicting the offset vertex comprises determining the offset vertex $P'_{i,k}$ from the equation:

$$\vec{P'}_{i,k} = \left(\vec{P}_{i,k} - \vec{A}\right) * \begin{bmatrix} \vec{s} \\ \vec{t} \\ \vec{r} \end{bmatrix}^{-1} \begin{bmatrix} \vec{s'} \\ \vec{t'} \\ \vec{r'} \end{bmatrix} + \vec{A'}$$

where:

$P_{i,k}$ is the reference vertex in the world space of the reference model;

A, *B*, *C* are vertices of the basis coordinate system in the world space of the reference model, and

s=*B*-*A*, *t*=*C*-*A*, and *r* is normal to *s* and *t*, and has a length equal to the average length of *s* and *t*;

A′, *B′*, *C′* are vertices of the basis coordinate system in the world space of the offset model, and

s′=*B′*-*A′*, *t′*=*C′*-*A′*, and *r′* is normal to *s′* and *t′*, and has a length equal to the average length of *s′* and *t′*.

13. The method of claim 1, further comprising:

selecting seed vertices; and

quantizing the seed vertices.

14. The method of claim 1, wherein predicting offset vertices comprises traversing the surface of the reference model in a zig-zag pattern.

15. The method of claim 1, wherein predicting offset vertices comprises traversing the surface of the reference model in a hierarchical traversal pattern.

16. The method of claim 1, wherein predicting offset vertices comprises traversing the surface of the reference model in a triangle-based traversal pattern.

17. The method of claim 1, further comprising quantizing the differences.

18. The method of claim 1, wherein each difference comprises a vector having vector components, each vector component associated with an axis of a coordinate system, further comprising:

reordering vector components of the difference so that vector components associated with each axis are stored contiguously.

19. The method of claim 1, wherein storing the differences comprises compressing the differences into a compressed data set using an entropy based compression algorithm.

20. The method of claim 1, further comprising compressing seed vertices using an entropy based compression algorithm.

21. A method for compressing an animation model, the model comprising an offset model including a plurality of surfaces, each surface including a plurality of vertices, the method comprising:

traversing a plurality of reference vertices on a surface of the reference model associated with the offset model, and for each reference vertex:

selecting an offset vertex of the offset model corresponding to the reference vertex;

selecting a basis coordinate system on the reference model with respect to the reference vertex, the basis coordinate system defined by vertices nearby the reference vertex, the basis coordinate system providing the basis coordinates for the reference vertex;

selecting a basis coordinate system on the offset model;

determining a position of the reference vertex in the basis coordinate system on the reference model; and

predicting the offset vertex by applying the position of the reference vertex in the basis coordinate system on the reference model to the basis coordinate system on the offset model;

determining a difference between the predicted offset vertex and an actual offset vertex of the offset model; and

storing the difference between the predicted offset vertex and actual offset vertex.

22. The method of claim 21, wherein at least one basis coordinate system comprises a set of vertices that are either seed vertices or vertices previously traversed.

23. The method of claim 21, wherein at least one basis coordinate system is a triangle defined by three vertices nearby the reference vertex.

24. The method of claim 21, wherein at least one basis coordinate system comprises a preconfigured triangle based on a location of the reference vertex.

25. The method of claim 21, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i,k-1}$, $P_{i+1,k-1}$, $P_{i+1,k-2}$ where the reference vertex is $P_{i,k}$, and is in an odd row of the surface.

26. The method of claim 21, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k-1}$, $P_{i,k-1}$, $P_{i,k-2}$, where the reference vertex is $P_{i,k}$, and is in an even row of the surface.

27. The method of claim 21, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k-1}$, $P_{i-1,k}$, $P_{i-2,k}$, where the reference vertex is $P_{i,k}$, and is in a last row of the surface.

28. The method of claim 21, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k}$, $P_{i,k+1}$, $P_{i-2,k+1}$,where the reference vertex is $P_{i,k}$, and is the leftmost vertex in a last and odd row of the surface.

29. The method of claim 21, wherein predicting the offset vertex comprises:

determining a reference vector for the position of the reference vertex in the basis coordinate system on the reference model; and

determining a corresponding offset vector for the reference vertex in the basis coordinate system of the offset model.

30. The method of claim 21, wherein predicting the offset vertex comprises determining the offset vertex $P'_{i,k}$ from the equation:

$$\vec{P'}_{i,k} = \left(\vec{P}_{i,k} - \vec{A}\right) * \begin{bmatrix} \vec{s} \\ \vec{t} \\ \vec{r} \end{bmatrix}^{-1} \begin{bmatrix} \vec{s}' \\ \vec{t}' \\ \vec{r}' \end{bmatrix} + \vec{A}'$$

where:

$P_{i,k}$ is the reference vertex in the world space of the reference model;

A, B, C are vertices of the basis coordinate system in the world space of the reference model, and

$s=B-A$, $t=C-A$, and r is normal to s and t, and has a length equal to the average length of s and t;

A', B', C' are vertices of the basis coordinate system in the world space of the offset model, and

$s'=B'-A'$, $t'=C'-A'$, and r' is normal to s' and t', and has a length equal to the average length of s' and t'.

31. The method of claim 1, further comprising:

selecting seed vertices; and

quantizing the seed vertices.

32. The method of claim 21, wherein traversing a plurality of reference vertices comprises traversing the reference vertices in a zig-zag pattern.

33. The method of claim 21, wherein traversing a plurality of reference vertices comprises traversing the reference vertices in a zig-zag pattern between adjacent rows of reference vertices.

34. The method of claim 21, wherein traversing a plurality of reference vertices comprises traversing the surface of the reference model in a hierarchical traversal pattern.

35. The method of claim 21, wherein traversing a plurality of reference vertices comprises traversing the surface of the reference model in a triangle-based traversal pattern.

36. The method of claim 21, wherein storing the difference between the predicted offset vertex and actual offset vertex comprises quantizing the difference before storing.

37. The method of claim 21, wherein storing the difference between the predicted offset vertex and actual offset vertex comprises reordering vector components of the difference so that vector components associated with each axis are stored contiguously.

38. The method of claim 21, wherein storing the difference between the predicted offset vertex and actual offset vertex comprises compressing the difference into a compressed data set using an entropy based compression algorithm.

39. The method of claim 21, further comprising compressing seed vertices using an entropy based compression algorithm.

40. A method for decompressing a compressed animation model, the model representing an offset model including a plurality of surfaces, each surface including a plurality of vertices, the method comprising:

predicting offset vertices of the offset model from corresponding reference vertices of a reference model associated with the offset model, using basis coordinate systems respectively associated with the reference vertices;

retrieving from the compressed animation model stored differences between the predicted offset vertices and actual offset vertices of the offset model; and

combining the predicted offset vertices and the stored differences to produce the offset vertices of the offset model.

41. The method of claim 40, wherein at least one basis coordinate system comprises a set of vertices that are either seed vertices or vertices previously traversed.

42. The method of claim 40, wherein at least one basis coordinate system is a triangle defined by three vertices nearby the reference vertex.

43. The method of claim 40, wherein at least one basis coordinate system comprises a preconfigured triangle based on a location of the reference vertex.

44. The method of claim 40, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i,k-1}$, $P_{i+1,k-1}$, $P_{i+1,k-2}$ where the reference vertex is $P_{i,k}$, and is in an odd row of the surface.

45. The method of claim 40, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k-1}$, $P_{i,k-1}$, $P_{i,k-2}$, where the reference vertex is $P_{i,k}$, and is in an even row of the surface.

46. The method of claim 40, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k-1}$, $P_{i-1,k}$, $P_{i-2,k}$, where the reference vertex is $P_{i,k}$, and is in a last row of the surface.

47. The method of claim 40, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k}$, $P_{i,k+1}$, $P_{i-2,k+1}$,where the reference vertex is $P_{i,k}$, and is the leftmost vertex in a last and odd row of the surface.

48. The method of claim 40, wherein predicting offset vertices comprises for each offset vertex:

selecting a reference vertex on the reference model and a corresponding offset vertex;

selecting a basis coordinate system on the reference model with respect to the reference vertex, the basis coordinate system defined by vertices nearby the reference vertex, the basis coordinate system providing the basis coordinates for the reference vertex;

selecting a basis coordinate system on the offset model;

determining a position of the reference vertex in the basis coordinate system; and

predicting the offset vertex by applying the position of the reference vertex in the basis coordinate system on the reference model to the basis coordinate system on the offset model.

49. The method of claim 48, wherein predicting the offset vertex, comprises:

determining a reference vector for the position of the reference vertex in the basis coordinate system on the reference model; and

determining a corresponding offset vector for the reference vertex in the basis coordinate system of the offset model.

50. The method of claim 48, wherein predicting the offset vertex, comprises determining the offset vertex $P'_{i,k}$ from the equation:

$$\vec{P'}_{i,k} = \left(\vec{P}_{i,k} - \vec{A}\right) * \begin{bmatrix} \vec{s} \\ \vec{t} \\ \vec{r} \end{bmatrix}^{-1} \begin{bmatrix} \vec{s'} \\ \vec{t'} \\ \vec{r'} \end{bmatrix} + \vec{A'}$$

where:

$P_{i,k}$ is the reference vertex in the world space of the reference model;

A, B, C are vertices of the basis coordinate system in the world space of the reference model, and

$s=B-A$, $t=C-A$, and r is normal to s and t, and has a length equal to the average length of s and t;

A', B', C' are vertices of the basis coordinate system in the world space of the offset model, and

$s'=B'-A'$, $t'=C'-A'$, and r' is normal to s' and t', and has a length equal to the average length of s' and t'.

51. The method of claim 40, wherein retrieving from the compressed animation model stored differences comprises:

reordering vector components of the differences from being continuously stored for each axis of a coordinate system to being grouped into coordinate tuple form.

52. The method of claim 40, retrieving from the compressed animation model stored differences comprises decompressing the differences into an uncompressed form using an entropy based decompression algorithm.

53. The method of claim 40, further comprising decompressing seed vertices into an uncompressed form using an entropy based decompression algorithm, and using the seed vertices as a reference vertices.

54. The method of claim 40, wherein predicting offset vertices comprises traversing the surface of the reference model in a zig-zag pattern.

55. The method of claim 40, wherein predicting offset vertices comprises traversing the surface of the reference model in a hierarchical traversal pattern.

56. The method of claim 40, wherein predicting offset vertices comprises traversing the surface of the reference model in a triangle-based traversal pattern.

57. A method for decompressing a compressed animation model, the model representing an offset model including a plurality of surfaces, each surface including a plurality of vertices, the method comprising:

traversing a plurality of reference vertices on a surface of a reference model associated with the offset model, and for each reference vertex:

retrieving from the compressed animation model a stored difference between a predicted offset vertex and an actual offset vertex of the offset model;

selecting a basis coordinate system on the reference model with respect to the reference vertex, the basis coordinate system defined by vertices nearby the reference vertex, the basis coordinate system providing the basis coordinates for the reference vertex;

selecting a basis coordinate system on the offset model;

determining a position of the reference vertex in the basis coordinate system on the reference model;

predicting the offset vertex by applying the position of the reference vertex in the basis coordinate system on the reference model to the basis coordinate system on the offset model; and

combining the predicted offset vertex and the stored difference to produce a final offset vertex of the offset model.

58. The method of claim 57, wherein at least one basis coordinate system comprises a set of vertices that are either seed vertices or vertices previously traversed.

59. The method of claim 57, wherein at least one basis coordinate system is a triangle defined by three vertices nearby the reference vertex.

60. The method of claim 57, wherein at least one basis coordinate system comprises a preconfigured triangle based on a location of the reference vertex.

61. The method of claim 57, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i,k-1}$, $P_{i+1,k-1}$, $P_{i+1,k-2}$ where the reference vertex is $P_{i,k}$, and is in an odd row of the surface.

62. The method of claim 57, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k-1}$, $P_{i,k-1}$, $P_{i,k-2}$, where the reference vertex is $P_{i,k}$, and is in an even row of the surface.

63. The method of claim 57, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k-1}$, $P_{i-1,k}$, $P_{i-2,k}$, where the reference vertex is $P_{i,k}$, and is in a last row of the surface.

64. The method of claim 57, wherein at least one basis coordinate system comprises a triangle defined by the vertices $P_{i-1,k}$, $P_{i,k+1}$, $P_{i-2,k+1}$,where the reference vertex is $P_{i,k}$, and is the leftmost vertex in a last and odd row of the surface.

65. The method of claim 57, wherein predicting the offset vertex, comprises:

determining a reference vector for the position of the reference vertex in the basis coordinate system on the reference model; and

determining a corresponding offset vector for the reference vertex in the basis coordinate system of the offset model.

66. The method of claim 57, wherein predicting the offset vertex, comprises determining the offset vertex $P'_{i,k}$ from the equation:

$$\vec{P}'_{i,k} = \left(\vec{P}_{i,k} - \vec{A}\right) * \begin{bmatrix} \vec{s} \\ \vec{t} \\ \vec{r} \end{bmatrix}^{-1} \begin{bmatrix} \vec{s}' \\ \vec{t}' \\ \vec{r}' \end{bmatrix} + \vec{A}'$$

where:

$P_{i,k}$ is the reference vertex in the world space of the reference model;

A, B, C are vertices of the basis coordinate system in the world space of the reference model, and

$s=B-A$, $t=C-A$, and r is normal to s and t, and has a length equal to the average length of s and t;

A', B', C' are vertices of the basis coordinate system in the world space of the offset model, and

$s'=B'-A'$, $t'=C'-A'$, and r' is normal to s' and t', and has a length equal to the average length of s' and t'.

67. The method of claim 57, wherein retrieving from the compressed animation model a stored difference comprises:

reordering vector components of the difference from being continuously stored for each axis of a coordinate system to being grouped into coordinate tuple form.

68. The method of claim 57, wherein retrieving from the compressed animation model a stored difference comprises decompressing the difference into an uncompressed form using an entropy based decompression algorithm.

69. The method of claim 57, further comprising decompressing a seed vertex into an uncompressed form using an entropy based decompression algorithm, and using the seed vertex as a reference vertex.

70. The method of claim 57, wherein traversing a plurality of reference vertices comprises traversing the surface of the reference model in a zig-zag pattern.

71. The method of claim 57, wherein traversing a plurality of reference vertices comprises traversing the surface of the reference model in a hierarchical traversal pattern.

72. The method of claim 57, wherein traversing a plurality of reference vertices comprises traversing the surface of the reference model in a triangle-based traversal pattern.

73. A computer program product, comprising a computer readable medium storing a compressed, offset animation model, the model comprising:

a plurality of seed vertices, each seed vertex corresponding to a row of reference vertices on a surface of a reference model associated with the offset model, the seed vertices for predicting a plurality of offset vertices on a surface of the offset model; and

a plurality of differences between predicted offset vertices and actual offset vertices, for combining with the plurality of offset vertices predicted from the seed vertices to produce a plurality of final offset vertices on the surface of the offset model.

74. The computer program product of claim 73, wherein the seed vertices are stored in quantized form.

75. The computer program product of claim 73, wherein the differences are stored in quantized form.

76. The computer program product of claim 73, wherein the differences comprise vector components of coordinate tuples, and the vector components for each axis of a coordinate system are stored continuously.

77. The computer program product of claim 73, wherein the seed vertices are stored in compressed form from an entropy-based compression algorithm.

78. The computer program product of claim 73, wherein the differences are stored in compressed form from an entropy-based compression algorithm.

79. A system for compressing an animation model, the model comprising an offset model including a plurality of surfaces, each surface including a plurality of vertices, the system comprising:

a model database that stores a reference model; and

a geometry compression module that predicts offset vertices of the offset model for corresponding reference vertices of the reference model associated with the offset model, using basis coordinate systems respectively associated with the reference vertices, determines differences between the predicted offset vertices and actual offset vertices of the offset model, and stores the differences between the predicted offset vertices and actual offset vertices as a compressed offset model in the model database to allow reconstruction of the actual offset vertices using the reference vertices and the differences.

80. The system of claim 79, further comprising:

a quantization module that quantizes the differences prior to storing in the compressed offset model.

81. The system of claim 79, each difference comprises a vector having vector components, each vector component associated with an axis of a coordinate system, the system further comprising:

a data reordering module that reorders the vector components of the differences so that vector components associated with each axis are stored contiguously.

82. The system of claim 79, further comprising:

a data compression module that compresses the differences using an entropy based compression algorithm prior to storing in the compressed offset model.

83. The system of claim 79, wherein the geometry compression module predicts offset vertices by:

selecting a reference vertex on the reference model and a corresponding offset vertex;

selecting a basis coordinate system on the reference model with respect to the reference vertex, the basis coordinate system defined by vertices nearby the reference vertex, the basis coordinate system providing the basis coordinates for the reference vertex;

selecting a basis coordinate system on the offset model;

determining a position of the reference vertex in the basis coordinate system; and

predicting the offset vertex by applying the position of the reference vertex in the basis coordinate system on the reference model to the basis coordinate system on the offset model.

84. A system for decompressing a compressed animation model, the model representing an offset model including a plurality of surfaces, each surface including a plurality of vertices, the system comprising:

a model database that stores a reference model and a compressed animation model; and

a geometry decompression module that predicts offset vertices of the offset model from corresponding reference vertices of the reference model associated with the offset model, using basis coordinate systems respectively associated with the reference vertices, retrieves from the compressed animation model stored differences between the predicted offset vertices and actual offset vertices of the offset model, and combines the predicted offset vertices and the stored differences to produce the offset vertices of the offset model.

85. The system of claim 84, further comprising:

a data decompression module that decompresses the stored differences using an entropy based decompression algorithm.

86. The system of claim 84, further comprising:

a data reordering module that reorders vector components of the differences from being continuously stored for each axis of a coordinate system to being grouped into coordinate tuple form.

87. The system of claim 84, wherein the geometry decompression module predicts offset vertices by:

selecting a reference vertex on the reference model and a corresponding offset vertex;

selecting a basis coordinate system on the reference model with respect to the reference vertex, the basis coordinate system defined by vertices nearby the reference vertex, the basis coordinate system providing the basis coordinates for the reference vertex;

selecting a basis coordinate system on the offset model;

determining a position of the reference vertex in the basis coordinate system; and

predicting the offset vertex by applying the position of the reference vertex in the basis coordinate system on the reference model to the basis coordinate system on the offset model.

88. A method for compressing and decompressing an animation model, the model comprising an offset model including a plurality of surfaces, each surface including a plurality of vertices, the method comprising:

predicting offset vertices of the offset model for corresponding reference vertices of a reference model associated with the offset model, using basis coordinate systems respectively associated with the reference vertices;

determining differences between the predicted offset vertices and actual offset vertices of the offset model;

storing the differences between the predicted offset vertices and actual offset vertices in a compressed animation model;

retrieving from the compressed animation model the stored differences;

predicting offset vertices of the offset model from corresponding reference vertices of the reference model associated with the offset model; and

combining the predicted offset vertices and the stored differences to produce the offset vertices of the offset model.

89. A method for compressing an animation model, the model comprising an offset model including a plurality of surfaces, each surface including a plurality of vertices, the method comprising:

compressing the animation model by compressing a geometric representation of the surface of the offset model at a first time with respect to a reference model at a second time earlier than the first time; and

storing the compressed representation.

90. A method for decompressing an animation model, the model comprising an offset model including a plurality of surfaces, each surface including a plurality of vertices, the method comprising:

retrieving a compressed geometric representation of a surface of the offset model at a first time with respect to a reference model at a second time earlier than the first time ; and

decompressing the compressed geometric representation with respect the reference model at the second time to produce the offset model at the first time.

91. A system for providing a compressed animation model for an animation cycle comprising a plurality of frames of animation of the animation model, the system comprising:

a reference model for the animation cycle, the reference model comprising a geometric representation describing a surface of the model for a first frame of animation cycle; and

a plurality of compressed, offset animation models, each compressed offset animation model corresponding to a subsequent frame of the animation cycle, and comprising a compressed geometric

representation of a surface of the offset model corresponding to the reference vertices.

92. The system of claim 91, wherein:

the reference model comprises a plurality of reference vertices describing the surface of the model; and

each compressed, offset animation model further comprises:

a plurality of seed vertices, each seed vertex corresponding to a row of reference vertices of the reference model associated with the offset model, the seed vertices for predicting a plurality of offset vertices on a surface of the offset model; and

a plurality of differences between predicted offset vertices and actual offset vertices, for combining with the plurality of offset vertices predicted from the seed vertices to produce a plurality of final offset vertices on the surface of the offset model.